

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : **10-256109** D3

(43)Date of publication of application : 25.09.1998

(51)Int.Cl.

H01L 21/02  
G06F 13/00

(21)Application number : 09-072806

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(22)Date of filing : 11.03.1997

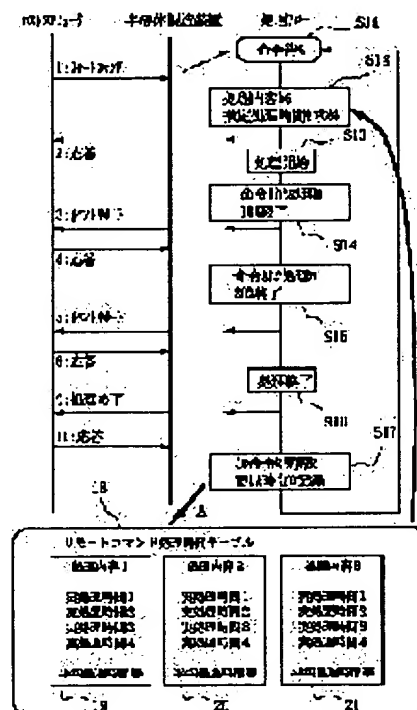
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## (54) SEMICONDUCTOR MANUFACTURING EQUIPMENT AND MANUFACTURE OF DEVICE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To increase productivity of semiconductor devices by enabling passing of necessary information between a manufacturing device and a host computer efficiently and without a hitch.

**SOLUTION:** A semiconductor manufacturing device is controlled by an information processing means provided with an interface which supports a protocol for sending back an answer message, if necessary, to a message from a host computer. When the information processing means receives a command message 1 from the host computer, it includes an estimated time for treating the command as a parameter in an answer message 2. In another way, after the information processing means receives a command message from the host computer and sends back an answer message, it sends data 3 and 5 concerning the progress of treatment of the command with a predetermined timing.



## LEGAL STATUS

[Date of request for examination]

13.12.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than  
the examiner's decision of rejection or  
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's  
decision of rejection]

[Date of requesting appeal against examiner's  
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## CLAIMS

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### [Claim(s)]

[Claim 1] They are the semiconductor fabrication machines and equipment characterized by to be what includes presumed time amount until processing of that command is completed in said reply message as one parameter when said information-processing means receives the message of a command from said host computer in the semiconductor fabrication machines and equipment with which it will have an information-processing means have the interface which supported the protocol which returns a reply message if required, and actuation is controlled by this information-processing means to the outgoing message from a host computer.

[Claim 2] Said information processing means are semiconductor fabrication machines and equipment according to claim 1 characterized by being what includes the purport of receipt of said command, and the data of activation propriety in said reply message.

[Claim 3] Said information processing means are semiconductor fabrication machines and equipment according to claim 1 or 2 characterized by being what acquires said presumed time amount in consideration of the processing time required before about processing of said same command.

[Claim 4] Said information processing means are semiconductor fabrication machines and equipment according to claim 3 characterized by being what acquires the more exact presumed processing time of the command by memorizing the presumed processing time of said a certain command, and the actually required time amount, and performing statistics processing to these processing times.

[Claim 5] Said information processing means are semiconductor fabrication machines and equipment according to claim 1 to 4 characterized by being what transmits the data about the progress situation of processing of the command to said host computer to predetermined timing after receiving the message of the command from said host computer and transmitting said reply message.

[Claim 6] They are the semiconductor fabrication machines and equipment characterized by to be what transmits the data about the progress situation of processing of that command to said host computer to predetermined timing after will have an information-processing means have the interface which supported the protocol which returns a reply message, to the outgoing message from a host computer if required, and said information-processing means receives the message of the command from said host computer in the semiconductor fabrication machines and equipment with which actuation is controlled by this information-processing means and transmitting said reply message.

[Claim 7] In the device manufacture approach of manufacturing a semiconductor device using one semiconductor fabrication machines and equipment of claims 1-5 When the message of a command is received from a host computer, in the reply message to it Presumed time amount until processing of the command is completed is included as one parameter. The device manufacture approach characterized by transmitting the reply message to a host computer, performing processing corresponding to said command after that, controlling actuation of said semiconductor fabrication machines and equipment, and manufacturing a semiconductor device.

[Claim 8] The device manufacture approach according to claim 7 characterized by transmitting the data about the progress situation of processing of said command to said host computer to predetermined

timing.

[Claim 9] The device manufacture approach characterized by manufacturing a semiconductor device while transmitting the required reply message to it, starting processing of the command after that and transmitting the data about the progress situation of the processing to said host computer to predetermined timing in the device manufacture approach of manufacturing a semiconductor device using the semiconductor fabrication machines and equipment of claim 6, when the message of the command from a host computer is received.

[Claim 10] It has the information processing means connected through the signal line by the cross cable corresponding to all the control of flow with which it is satisfied of RS-232 C specification to a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means If there is a data communication demand which supervised the input through said all signal lines that are possible in RS-232-C specification, and minded signal lines other than AA, BA, BB, and AB from said host computer Semiconductor fabrication machines and equipment characterized by providing a means to form a communication link by performing the reply according to this through a corresponding signal line.

[Claim 11] In the semiconductor fabrication machines and equipment with which it has an information processing means to have the means of communications through the communication link interface according to SECS-1 between host computers, and actuation is controlled by this information processing means Said communication link interface as a physical interface Between said host KOMPYUTA and said information processing means, It adds to connection by the signal line of AA, BA, BB, and AB by the connector of D type 25 pin. It has connection by the cross cable of CA, CB, CC, and CD. Said means of communications Semiconductor fabrication machines and equipment characterized by providing a means to form a communication link by performing the reply according to this through a corresponding signal line if there is a data communication demand which minded signal lines other than AA, BA, BB, and AB from said host computer.

[Claim 12] In the semiconductor fabrication machines and equipment with which it has an information processing means to have the means of communications through the communication link interface according to SECS-1 between host computers, and actuation is controlled by this information processing means Said communication link interface as a physical interface Between said host KOMPYUTA and said information processing means, In addition to connection by the signal line of BA, BB, and AB by the connector of D type 9 pin, it has connection by the cross cable of CA, CB, CC, and CD. Said means of communications Semiconductor fabrication machines and equipment characterized by providing a means to form a communication link by performing the reply according to this through a corresponding signal line if there is a data communication demand which minded signal lines other than BA, BB, and AB from said host computer.

[Claim 13] When a Request to Send (CA) is received from said host computer, said means of communications When reply of ready for sending (CB) according to this and reception of data (BB) are performed and data terminal ready (CD) is received from said host computer Reply of the data set ready (CC) according to this and transmission of data (BA) are performed. When neither a Request to Send (CA) nor data terminal ready (CD) has received from said host computer Semiconductor fabrication machines and equipment according to claim 11 or 12 characterized by being what performs transmission of data (BA), or reception of data (BB) between said host computers if needed.

[Claim 14] The device manufacture approach characterized by exchanging required information through the means of communications between the host computer, controlling actuation of said semiconductor fabrication machines and equipment based on those information using one semiconductor fabrication machines and equipment of claims 10-13, and manufacturing a semiconductor device.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the device manufacture approach using the semiconductor fabrication machines and equipment and this which were connected with the host computer which performs information interchange with the semiconductor fabrication machines and equipment in a computer or a computer network, and controls semiconductor fabrication machines and equipment.

[0002]

[Description of the Prior Art] when the actual processing which activation of a remote command tells the success or failure of whether it is possible in the present condition and the communications processing of reception and a reply to a host computer, and a remote command means is completed on the occasion of reception of a remote command message etc., and reply processing, the purport which processing ended tells a host computer in semiconductor fabrication machines and equipment with the interface which supported the protocol which will return a reply message to the outgoing message from a host computer conventionally if required.

[0003] However, the host computer which controls semiconductor fabrication machines and equipment is developed every year, and there are also many situations of wanting to grasp a fine device status on a host computer, especially in control of the semiconductor fabrication machines and equipment of the format of notifying to this that the activity situation by the event is the remote command which orders the activity which takes time amount, an activity is completed when, or it has the problem that anticipation does not stick. Then, the following technical problems are mentioned to semiconductor fabrication machines and equipment.

**\*\* Semiconductor fabrication machines and equipment need to notify to a host computer by how much time amount processing according to the instruction by the command received from the host computer can be performed.**

**\*\* Presumption of the duration of the processing to notify needs to be exact as much as possible.**

**\*\* Semiconductor fabrication machines and equipment need to report serially how many current processings are progressing to a host computer.**

[0004] On the other hand, SECS-1 which defines the communication link interface about the message transmission and reception between semiconductor fabrication machines and equipment and a host computer supposes that AA (pin1), BA (pin2), BB (pin3), and AB (pin7) (a signal name is based on EIA RS-232C specification) are connection of the required signal line in all equipments. Moreover, when using the other signal line, it is supposed that it must be based on RS-232 C specification. And in the semiconductor fabrication machines and equipment based on SECS-1, it came conventionally as what is connected with a host computer only using AA (pin1), BA (pin2), BB (pin3), and AB (pin7) which are shown in SECS-1. A host computer AA (pin1), BA (pin2), BB (pin3), Since semiconductor fabrication machines and equipment are not using only AA (pin1), BA (pin2), BB (pin3), and AB (pin7) when you need the connection (use of CA and CC etc.) by signal lines other than AB (pin7), in the cross cable

between a host computer and semiconductor fabrication machines and equipment, physically, signal lines other than AA (pin1), BA (pin2), BB (pin3), and AB (pin7) were short-circuited so that a communication link might be materialized with CD CA -- CB and CC.

[0005] However, as shown below, it goes across the connection method of a physical signal line demanded by the host variably.

**\*\* Connection of the signal line of only AA (pin1), BA (pin2), BB (pin3), and AB (pin7) (fundamental plan of SECS-1)**

It adds to connection of **\*\* \*\***, and is connection (based on RS-232 C) of the signal line of CD (20pin) and CC (6pin).

It adds to connection of **\*\* \*\***, and is connection (based on RS-232 C) of the signal line of CA (4pin) and CB (5pin).

It adds to connection of **\*\* \*\***, and is connection (based on RS-232 C) of the signal line of CD, CC, CA, and CB.

[0006] In order to fill the above demand, it is complicated to prepare a cross cable with which a communication link is materialized according to each case between a host computer and semiconductor fabrication machines and equipment. Moreover, the communication failure by the selection mistake of a cross cable may also be encountered (communication failure will be encountered if an unnecessary signal line is connected).

[0007] The purpose of this invention is shown in attaining the increase in efficiency of manufacture of a semiconductor device in semiconductor fabrication machines and equipment and an approach, in view of the above-mentioned conventional trouble, as required information between host computers can be delivered and received efficiently convenient.

[0008]

[Means for Solving the Problem] In the semiconductor fabrication machines and equipment which take like 1 voice as for this invention in order to attain this purpose It has an information processing means to have the interface which supported the protocol which will return a reply message if required, to the outgoing message from a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means said information processing means When the message of a command is received from said host computer, it is characterized by being what includes presumed time amount until processing of the command is completed in said reply message as one parameter.

[0009] Moreover, it sets to the device manufacture approach which takes like 1 voice as for this invention. In the device manufacture approach of manufacturing a semiconductor device using such semiconductor fabrication machines and equipment When the message of a command is received from a host computer, in the reply message to it Presumed time amount until processing of the command is completed is included as one parameter. The reply message is transmitted to a host computer, processing corresponding to said command is performed after that, actuation of said semiconductor fabrication machines and equipment is controlled, and it is characterized by manufacturing a semiconductor device.

[0010] Moreover, it sets to the semiconductor fabrication machines and equipment concerning other modes of this invention. It has an information processing means to have the interface which supported the protocol which will return a reply message if required, to the outgoing message from a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means said information processing means After receiving the message of the command from said host computer and transmitting said reply message, it is characterized by being what transmits the data about the progress situation of processing of the command to said host computer to predetermined timing.

[0011] Moreover, it sets to the device manufacture approach concerning other modes of this invention. In the device manufacture approach of manufacturing a semiconductor device using the semiconductor fabrication machines and equipment concerning a mode besides the above When the message of the command from a host computer is received, the required reply message to it is transmitted. Then, it is characterized by manufacturing a semiconductor device, starting processing of the command and

transmitting the data about the progress situation of the processing to said host computer to predetermined timing.

[0012] moreover, in the semiconductor fabrication machines and equipment concerning another mode of this invention It has the information processing means connected through the signal line by the cross cable corresponding to all the control of flow with which it is satisfied of RS-232 C specification to a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means If there is a data communication demand which supervised the input through said all signal lines that are possible in RS-232-C specification, and minded signal lines other than AA, BA, BB, and AB from said host computer It is characterized by providing a means to form a communication link by performing the reply according to this through a corresponding signal line.

[0013] moreover, another voice of this invention -- it is characterized by exchanging required information through the means of communications between the host computer, controlling actuation of said semiconductor fabrication machines and equipment by the device manufacture approach which starts like based on those information using such semiconductor fabrication machines and equipment, and manufacturing a semiconductor device.

[0014]

[Embodiment of the Invention] In the semiconductor fabrication machines and equipment and the device manufacture approach of said this invention which take like 1 voice, when a command (remote command) is received from a host computer, data, such as receipt of a command, activation propriety, and success or failure of reception reply communications processing, can be included in the reply message.

[0015] Moreover, the presumed time amount which processing of a command takes can be acquired in consideration of the processing time required before about processing of the same command. The more exact presumed processing time of the command can be acquired by more specifically memorizing the presumed processing time of a certain command, and the actually required time amount, and performing statistics processing to these processing times. That is, about each processing which may be ordered as a remote command of an outgoing message from a host computer, the real processing time is accumulated by multiple times, and based on this, the presumed processing time is recomputed more to a right thing, and it notifies to a host computer at the time of reply message sending. More exact processing presumption time amount can be notified to a host computer, so that this repeats many processing run commands from a host computer.

[0016] Thus, when the outgoing message from a host computer is an instruction of the processing activation by a remote command etc., it also becomes possible by reporting it to a host computer, using the presumed duration of the processing other than the present condition possible propriety of the command, or the success or failure of reception reply communications processing as a reply message for a host computer to grasp roughly how much semiconductor fabrication machines and equipment complete processing, for example, to perform another processing previously in parallel. Moreover, even if it goes through a presumed duration sharply, when there is still no report which shows processing termination from semiconductor fabrication machines and equipment, it can detect that a certain trouble arose in the processing itself. Furthermore by seeing a host computer, an operator can judge whether whose operation to the time amount of after how much and semiconductor fabrication machines and equipment is unnecessary.

[0017] Moreover, in other modes of said this invention, the data about the progress situation of processing of the remote command from a host computer are notified to a host computer as an event report, for example. Thereby, a host computer can grasp how many actual processings are progressing according to the presumed processing time.

[0018] In the semiconductor fabrication machines and equipment and the device manufacture approach of on the other hand starting another mode of this invention In the semiconductor fabrication machines and equipment with which it has an information processing means to have the means of communications which specifically minded the communication link interface according to SECS-1 between host

computers, and actuation is controlled by this information processing means Said communication link interface as a physical interface Between said host KOMPYUTA and said information processing means, It adds to connection by the signal line of AA, BA, BB, and AB by the connector of D type 25 pin. It has connection by the cross cable of CA, CB, CC, and CD. Said means of communications If there is a data communication demand which minded signal lines other than AA, BA, BB, and AB from said host computer, a means to form a communication link is provided by performing the reply according to this through a corresponding signal line.

[0019] Said communication link interface or as a physical interface Are based on the connector of D type 9 pin between said host KOMPYUTA and said information processing means. In addition to connection by the signal line of BA, BB, and AB, it has connection by the cross cable of CA, CB, CC, and CD. Said means of communications If there is a data communication demand which minded signal lines other than BA, BB, and AB from said host computer, a means to form a communication link is provided by performing the reply according to this through a corresponding signal line.

[0020] When said means of communications performs reply of ready for sending (CB) according to this, and reception of data (BB) when a Request to Send (CA) is received from a host computer, and data terminal ready (CD) is received from said host computer, by performing reply of the data set ready (CC) according to this, and transmission of data (BA), it forms said communication link, and data can be transmitted and received. And when neither a Request to Send (CA) nor data terminal ready (CD) has received from said host computer, transmission of data (BA) or reception of data (BB) can be performed between said host computers if needed.

[0021] thus, even when the host computer is demanding the connection method of what kind of signal line The cable used between a host computer and semiconductor fabrication machines and equipment is set to one of the connection methods of the signal line by the cross cable (the usual cross cable) corresponding to all the control of flow of RS-232 C specification. If all the pins that are possible to RS-232-C specification are supervised and there is a demand from a host computer The difference in the signal-line connection which a host demands by the semiconductor-fabrication-machines-and-equipment side is absorbable by forming a communication link by returning a response to pins other than AA (pin1), BA (pin2), BB (pin3), and AB (pin7) regardless of the procedure of transmission and reception.

[0022]

[Example] The example of this invention is explained using a drawing below.

[1st example] drawing 2 is drawing showing the structure of a system containing the semiconductor fabrication machines and equipment concerning the 1st example of this invention. As shown in this drawing, this system has semiconductor fabrication machines and equipment 21 and the host computer 22 which controls it, and semiconductor fabrication machines and equipment 21 and a host computer 22 are connected by an RS-232C interface or Ethernet (TCP/IP).

[0023] Generally the interface near [ that / after a physical interface ] application is based on the protocol by SEMI (SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL), SECS-1, SECS-2, HSMS, etc. What is necessary is just to support the communication link interface which answers a letter in a reply message to the outgoing message from a host computer, if required even when not dependent on those protocols.

[0024] Drawing 1 is drawing showing the communication link and the contents of processing in semiconductor fabrication machines and equipment 21. As shown in this drawing, semiconductor fabrication machines and equipment are in the condition (step S11) of waiting for the instruction from a host computer first. In this condition, if a certain instruction is sent by the remote command message 1 from a host computer, semiconductor fabrication machines and equipment will require how much time amount for that instruction, or will put the processing presumption time amount which found and found processing presumption time amount based on the instruction from a host computer on a response message 2 with reference to the remote command processing-time table 18, and will report it to a host computer (step S12). After the transaction of this remote command is completed, semiconductor fabrication machines and equipment start the processing ordered by the command (step S13). And when processing of the rate of the arbitration of the ordered processing is completed, semiconductor

fabrication machines and equipment notify to a host computer whether current and what percent of processing were completed as event report messages 3 and 5 (steps S14 and S15).

[0025] Semiconductor fabrication machines and equipment usually transmit the message 9 which tells the purport which processing ended to a host computer, after ending processing of the instruction by the remote command from a host computer (step S16). After receiving the response 10 to a message 9 and completing the transaction of a message 9, it records on the table 19 which has the contents of processing which are equivalent to this instruction in the remote command processing-time table 18 in fact [ how much ] semiconductor fabrication machines and equipment were applied to processing the instruction by the remote command 1 from a host computer, for example, a table etc., (step S17). It returns to the condition (step S11) of the waiting for an instruction by the remote command from a host computer again after that.

[0026] Next, if the remote command which shows the instruction execution same with having processed previously is transmitted from a host computer, the response of a remote command which carried the presumed activation duration which became still more exact than previously can be returned to a host computer (step S12).

[0027] The [2nd example] table 1 shows the role of each pin in RS-232 C specification used by this example. In order one pin is called AA, two pins are called BA to \*\*\*\* for security, three pins are called BB to transmit data, four pins are called CA to received data, and five pins are called CB to Requests to Send and to show ready-for-sending ability In order to call six pins CC and to show a data set ready, seven pins are called AB, and 20 pins are used for the signal ground in order to be referred to as CD and to show a data end ready.

[0028]

[Table 1]

Table 1 : RS - 232 - C 各ピンの働き

ピン	略 称	用 途
1	AA	保安用接地
2	BA	送信データ
3	BB	受信データ
4	CA	送信要求
5	CB	送信可
6	CC	データセットレディ
7	AB	信号用接地
20	CD	データ端末レディ

[0029] Drawing 3 shows wiring of the cross cable corresponding to all the control of flow used by RS-232 C. The figure in drawing is the number of a pin. In this example, the cable of wiring of drawing 1 is used as a physical interface between a host computer and semiconductor fabrication machines and equipment. The figure in drawing is the number of the pin in both connectors. As shown in this drawing, this cable connects one pin to one pin of a partner, and two pins are connected to three pins of a partner. Four pins are connected to five pins of a partner, and six pins are connected to 20 pins of a partner. Seven pins are connected to seven pins of a partner.

[0030] Drawing 4 shows positioning of the procedure by which it is characterized [ of this example ]. As shown in this drawing, the characteristic part 15 of this example is between semiconductor fabrication machines and equipment 14 and the cross connection 16 of drawing 1 which connects a host computer 17 with this, and is connected with the host computer 17 through the cross connection 16.

[0031] Drawing 5 shows the communication procedure in the usual RS-232 C. In the communication link based on the usual RS-232 C, since each other control of flow is expected, unless a Request to Send is received from a communications partner, reception of data is not started. When transmitting data to a communications partner, unless similarly it surely receives a data end ready, a partner will not be in the condition that data are receivable.

[0032] This concrete communication procedure is shown according to drawing 5. If a communication link is started, semiconductor fabrication machines and equipment investigate whether the Request to Send was received from the communications partner (step S2), when having received the Request to Send, they will transmit that it is ready-for-sending ability to a communications partner (step S3), and will receive data (step S4). If the Request to Send is not received from a communications partner, it investigates whether data terminal ready is received (step S5), and since data transmission can be carried out at a communications partner if data terminal ready is received, a data set ready is transmitted to a communications partner (step S6), and data are transmitted after that (step S7). If data terminal ready is not received, it returns to decision (SUTTEPU S2) whether the Request to Send was received after fixed time amount etc. again. The rest continues the half-duplex communication link by the above repeat.

[0033] When the semiconductor fabrication machines and equipment and the host computer concerning this example are connected with the cable of drawing 3, drawing 6 shows the communication procedure for forming a communication link, even if it is demanding the control of flow whose host computer is a communication procedure using pins other than AA (pin1), BA (pin2), BB (pin3), and AB (pin7). It is the characteristic part of this invention. In SECS-1, since it has set to the procedure of transmission and reception of the message exchanged between two devices (here, they are semiconductor fabrication machines and equipment and a host) which communicate by half-duplex communication link, the control of flow by the control of flow, CC, or CD by CA and CB which are shown in more general RS-232C specification is not needed. The semiconductor fabrication machines and equipment based on SECS-1 from this can form the communication link with the host computer with which the physical interface etc. was based on SECS-1 (message transceiver agreement etc.) with the following procedures.

[0034] That is, if a communication link is started, it would investigate whether the Request to Send was received from the communications partner (step S41) and the Request to Send will be received as shown in drawing 6, ready-for-sending ability will be transmitted to a communications partner (step S42), and reception of data will be performed after that (step S45). If the Request to Send is not received, and it investigated whether data terminal ready was received from the communications partner (step S43) and has received, a data set ready will be transmitted to a communications partner (step S44), and transmission of data will be performed after that (step S45). If data terminal ready is not received, reception and/or transmission of data can be performed if needed (step S45). As long as it is based on the protocol of SECS-1, while what is necessary is just to have carried out it when it transmitted data and excelled in step S45, since a communicative collision could not take place and having received data, the demand of transmission does not take place. Return and a half-duplex communication link are henceforth continued to step S41 after fixed time amount progress etc.

[0035] Next, the example of device manufacture which can use the above semiconductor fabrication machines and equipment is explained. Drawing 7 shows the flow of manufacture of minute devices (semiconductor chips, such as IC and LSI, a liquid crystal panel, CCD, the thin film magnetic head, micro machine, etc.). The circuit design of a semiconductor device is performed at step 31 (circuit design). The mask in which the designed circuit pattern was formed is manufactured at step 32 (mask manufacture). On the other hand, at step 33 (wafer manufacture), a wafer is manufactured using ingredients, such as silicon. Step 34 (wafer process) is called a last process, and forms an actual circuit on a wafer with a lithography technique using the mask and wafer which carried out [ above-mentioned ] preparation. The following step 35 (assembly) is called a back process, is a process semiconductor-chip-ized using the wafer produced by step 34, and includes processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At step 36 (inspection), the check test of the semiconductor device produced at step 35 of operation, an endurance test, etc. are

inspected. A semiconductor device is completed through such a process and this is shipped (step 37). [0036] Drawing 8 shows the detailed flow of the above-mentioned wafer process. The front face of a wafer is oxidized at step 41 (oxidation). An insulator layer is formed in a wafer front face at step 42 (CVD). At step 43 (electrode formation), an electrode is formed by vacuum evaporation on a wafer. Ion is driven into a wafer at step 44 (ion implantation). A sensitization agent is applied to a wafer at step 45 (resist processing). At step 46 (exposure), printing exposure of the circuit pattern of a mask is carried out with an aligner at a wafer. The exposed wafer is developed at step 47 (development). At step 48 (etching), parts other than the developed resist image are shaved off. The resist which etching ended and became unnecessary is removed at step 49 (resist exfoliation). A circuit pattern is formed on a wafer by carrying out by repeating these steps multiplex.

[0037] If the manufacture approach of this operation gestalt is used, the semiconductor device of a high degree of integration for which manufacture was difficult can be conventionally manufactured by low cost.

[0038]

[Effect of the Invention] Since it was made according to this invention to include presumed time amount until processing of the command is completed in the reply message to it as one parameter when the message of a command is received from a host computer as explained above, a host computer can attain the increase in efficiency of manufacture of a semiconductor device by carrying out previously or detecting the abnormalities of processing for another processing in parallel, etc. based on the presumed time amount. Moreover, an operator can judge whether whose operation to the time amount of after how much and semiconductor fabrication machines and equipment is unnecessary by seeing the presumed time amount.

[0039] Moreover, since the presumed time amount which processing of the command takes in consideration of the processing time required before about processing of said same command was acquired, exact presumed time amount can be acquired.

[0040] Moreover, since the data about the progress situation of processing of the command were transmitted to said host computer to predetermined timing after receiving the message of the command from a host computer and transmitting the reply message, a host computer can grasp how many actual processings are progressing, and can make a required judgment for manufacturing a semiconductor device efficiently based on this.

[0041] Moreover, if there is a data communication demand which supervised the input through all the signal lines that are possible in RS-232-C specification, and minded signal lines other than AA, BA, BB, and AB from the host computer Since it was made to form a communication link by performing the reply according to this through a corresponding signal line, The need of exchanging the interconnection cable of semiconductor fabrication machines and equipment and a host computer according to the connection method of a signal line which a host computer requires can be abolished, and the communication failure by the selection mistake of a cable can be prevented.

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**TECHNICAL FIELD**

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[Field of the Invention] This invention relates to the device manufacture approach using the semiconductor fabrication machines and equipment and this which were connected with the host computer which performs information interchange with the semiconductor fabrication machines and equipment in a computer or a computer network, and controls semiconductor fabrication machines and equipment.

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] Since it was made according to this invention to include presumed time amount until processing of the command is completed in the reply message to it as one parameter when the message of a command is received from a host computer as explained above, a host computer can attain the increase in efficiency of manufacture of a semiconductor device by carrying out previously or detecting the abnormalities of processing for another processing in parallel, etc. based on the presumed time amount. Moreover, an operator can judge whether whose operation to the time amount of after how much and semiconductor fabrication machines and equipment is unnecessary by seeing the presumed time amount.

[0039] Moreover, since the presumed time amount which processing of the command takes in consideration of the processing time required before about processing of said same command was acquired, exact presumed time amount can be acquired.

[0040] Moreover, since the data about the progress situation of processing of the command were transmitted to said host computer to predetermined timing after receiving the message of the command from a host computer and transmitting the reply message, a host computer can grasp how many actual processings are progressing, and can make a required judgment for manufacturing a semiconductor device efficiently based on this.

[0041] Moreover, since it was made to form a communication link by performing the reply according to this through a corresponding signal line if there is a data communication demand which supervised the input through all the signal lines that are possible in RS-232-C specification, and minded signal lines other than AA, BA, BB, and AB from the host computer. The need of exchanging the interconnection cable of semiconductor fabrication machines and equipment and a host computer according to the connection method of a signal line which a host computer requires can be abolished, and the communication failure by the selection mistake of a cable can be prevented.

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[Translation done.]

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**TECHNICAL PROBLEM**

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[Description of the Prior Art] when the actual processing which activation of a remote command tells the success or failure of whether it is possible in the present condition and the communications processing of reception and a reply to a host computer, and a remote command means is completed on the occasion of reception of a remote command message etc., and reply processing, the purport which processing ended tells a host computer in semiconductor fabrication machines and equipment with the interface which supported the protocol which will return a reply message to the outgoing message from a host computer conventionally if required.

[0003] However, the host computer which controls semiconductor fabrication machines and equipment is developed every year, and there are also many situations of wanting to grasp a fine device status on a host computer, especially in control of the semiconductor fabrication machines and equipment of the format of notifying to this that the activity situation by the event is the remote command which orders the activity which takes time amount, an activity is completed when, or it has the problem that anticipation does not stick. Then, the following technical problems are mentioned to semiconductor fabrication machines and equipment.

**\*\* Semiconductor fabrication machines and equipment need to notify to a host computer by how much time amount processing according to the instruction by the command received from the host computer can be performed.**

**\*\* Presumption of the duration of the processing to notify needs to be exact as much as possible.**

**\*\* Semiconductor fabrication machines and equipment need to report serially how many current processings are progressing to a host computer.**

[0004] On the other hand, SECS-1 which defines the communication link interface about the message transmission and reception between semiconductor fabrication machines and equipment and a host computer supposes that AA (pin1), BA (pin2), BB (pin3), and AB (pin7) (a signal name is based on EIA RS-232C specification) are connection of the required signal line in all equipments. Moreover, when using the other signal line, it is supposed that it must be based on RS-232 C specification. And in the semiconductor fabrication machines and equipment based on SECS-1, it came conventionally as what is connected with a host computer only using AA (pin1), BA (pin2), BB (pin3), and AB (pin7) which are shown in SECS-1. A host computer is AA (pin1), BA (pin2), and BB (pin3). Since semiconductor fabrication machines and equipment are not using only AA (pin1), BA (pin2), BB (pin3), and AB (pin7) when you need the connection (use of CA and CC etc.) by signal lines other than AB (pin7), in the cross cable between a host computer and semiconductor fabrication machines and equipment, physically, signal lines other than AA (pin1), BA (pin2), BB (pin3), and AB (pin7) were short-circuited so that a communication link might be materialized with CD CA -- CB and CC.

[0005] However, as shown below, it goes across the connection method of a physical signal line demanded by the host variably.

**\*\* Connection of the signal line of only AA (pin1), BA (pin2), BB (pin3), and AB (pin7) (fundamental plan of SECS-1)**

It adds to connection of **\*\* \*\***, and is connection (based on RS-232 C) of the signal line of CD (20pin)

and CC (6pin).

It adds to connection of \*\* \*\*, and is connection (based on RS-232 C) of the signal line of CA (4pin) and CB (5pin).

It adds to connection of \*\* \*\*, and is connection (based on RS-232 C) of the signal line of CD, CC, CA, and CB.

[0006] In order to fill the above demand, it is complicated to prepare a cross cable with which a communication link is materialized according to each case between a host computer and semiconductor fabrication machines and equipment. Moreover, the communication failure by the selection mistake of a cross cable may also be encountered (communication failure will be encountered if an unnecessary signal line is connected).

[0007] The purpose of this invention is shown in attaining the increase in efficiency of manufacture of a semiconductor device in semiconductor fabrication machines and equipment and an approach, in view of the above-mentioned conventional trouble, as required information between host computers can be delivered and received efficiently convenient.

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**MEANS**

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[Means for Solving the Problem] In the semiconductor fabrication machines and equipment which take like 1 voice as for this invention in order to attain this purpose It has an information processing means to have the interface which supported the protocol which will return a reply message if required, to the outgoing message from a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means said information processing means When the message of a command is received from said host computer, it is characterized by being what includes presumed time amount until processing of the command is completed in said reply message as one parameter.

[0009] Moreover, it sets to the device manufacture approach which takes like 1 voice as for this invention. In the device manufacture approach of manufacturing a semiconductor device using such semiconductor fabrication machines and equipment When the message of a command is received from a host computer, in the reply message to it Presumed time amount until processing of the command is completed is included as one parameter. The reply message is transmitted to a host computer, processing corresponding to said command is performed after that, actuation of said semiconductor fabrication machines and equipment is controlled, and it is characterized by manufacturing a semiconductor device.

[0010] Moreover, it sets to the semiconductor fabrication machines and equipment concerning other modes of this invention. It has an information processing means to have the interface which supported the protocol which will return a reply message if required, to the outgoing message from a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means said information processing means After receiving the message of the command from said host computer and transmitting said reply message, it is characterized by being what transmits the data about the progress situation of processing of the command to said host computer to predetermined timing.

[0011] Moreover, it sets to the device manufacture approach concerning other modes of this invention. In the device manufacture approach of manufacturing a semiconductor device using the semiconductor fabrication machines and equipment concerning a mode besides the above When the message of the command from a host computer is received, the required reply message to it is transmitted. Then, it is characterized by manufacturing a semiconductor device, starting processing of the command and transmitting the data about the progress situation of the processing to said host computer to predetermined timing.

[0012] moreover, in the semiconductor fabrication machines and equipment concerning another mode of this invention It has the information processing means connected through the signal line by the cross cable corresponding to all the control of flow with which it is satisfied of RS-232 C specification to a host computer. In the semiconductor fabrication machines and equipment with which actuation is controlled by this information processing means If there is a data communication demand which supervised the input through said all signal lines that are possible in RS-232-C specification, and minded signal lines other than AA, BA, BB, and AB from said host computer It is characterized by providing a means to form a communication link by performing the reply according to this through a corresponding

signal line.

[0013] moreover, another voice of this invention -- it is characterized by exchanging required information through the means of communications between the host computer, controlling actuation of said semiconductor fabrication machines and equipment by the device manufacture approach which starts like based on those information using such semiconductor fabrication machines and equipment, and manufacturing a semiconductor device.

[0014]

[Embodiment of the Invention] In the semiconductor fabrication machines and equipment and the device manufacture approach of said this invention which take like 1 voice, when a command (remote command) is received from a host computer, data, such as receipt of a command, activation propriety, and success or failure of reception reply communications processing, can be included in the reply message.

[0015] Moreover, the presumed time amount which processing of a command takes can be acquired in consideration of the processing time required before about processing of the same command. The more exact presumed processing time of the command can be acquired by more specifically memorizing the presumed processing time of a certain command, and the actually required time amount, and performing statistics processing to these processing times. That is, about each processing which may be ordered as a remote command of an outgoing message from a host computer, the real processing time is accumulated by multiple times, and based on this, the presumed processing time is recomputed more to a right thing, and it notifies to a host computer at the time of reply message sending. More exact processing presumption time amount can be notified to a host computer, so that this repeats many processing run commands from a host computer.

[0016] Thus, when the outgoing message from a host computer is an instruction of the processing activation by a remote command etc., it also becomes possible by reporting it to a host computer, using the presumed duration of the processing other than the present condition possible propriety of the command, or the success or failure of reception reply communications processing as a reply message for a host computer to grasp roughly how much semiconductor fabrication machines and equipment complete processing, for example, to perform another processing previously in parallel. Moreover, even if it goes through a presumed duration sharply, when there is still no report which shows processing termination from semiconductor fabrication machines and equipment, it can detect that a certain trouble arose in the processing itself. Furthermore by seeing a host computer, an operator can judge whether whose operation to the time amount of after how much and semiconductor fabrication machines and equipment is unnecessary.

[0017] Moreover, in other modes of said this invention, the data about the progress situation of processing of the remote command from a host computer are notified to a host computer as an event report, for example. Thereby, a host computer can grasp how many actual processings are progressing according to the presumed processing time.

[0018] In the semiconductor fabrication machines and equipment and the device manufacture approach of on the other hand starting another mode of this invention In the semiconductor fabrication machines and equipment with which it has an information processing means to have the means of communications which specifically minded the communication link interface according to SECS-1 between host computers, and actuation is controlled by this information processing means Said communication link interface as a physical interface Between said host KOMPYUTA and said information processing means, It adds to connection by the signal line of AA, BA, BB, and AB by the connector of D type 25 pin. It has connection by the cross cable of CA, CB, CC, and CD. Said means of communications If there is a data communication demand which minded signal lines other than AA, BA, BB, and AB from said host computer, a means to form a communication link is provided by performing the reply according to this through a corresponding signal line.

[0019] Said communication link interface or as a physical interface Are based on the connector of D type 9 pin between said host KOMPYUTA and said information processing means. In addition to connection by the signal line of BA, BB, and AB, it has connection by the cross cable of CA, CB, CC,

and CD. Said means of communications If there is a data communication demand which minded signal lines other than BA, BB, and AB from said host computer, a means to form a communication link is provided by performing the reply according to this through a corresponding signal line.

[0020] When said means of communications performs reply of ready for sending (CB) according to this, and reception of data (BB) when a Request to Send (CA) is received from a host computer, and data terminal ready (CD) is received from said host computer, by performing reply of the data set ready (CC) according to this, and transmission of data (BA), it forms said communication link, and data can be transmitted and received. And when neither a Request to Send (CA) nor data terminal ready (CD) has received from said host computer, transmission of data (BA) or reception of data (BB) can be performed between said host computers if needed.

[0021] thus, even when the host computer is demanding the connection method of what kind of signal line The cable used between a host computer and semiconductor fabrication machines and equipment is set to one of the connection methods of the signal line by the cross cable (the usual cross cable) corresponding to all the control of flow of RS-232 C specification. If all the pins that are possible to RS-232-C specification are supervised and there is a demand from a host computer The difference in the signal-line connection which a host demands by the semiconductor-fabrication-machines-and-equipment side is absorbable by forming a communication link by returning a response to pins other than AA (pin1), BA (pin2), BB (pin3), and AB (pin7) regardless of the procedure of transmission and reception.

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**EXAMPLE**

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[Example] The example of this invention is explained using a drawing below.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the communication link and the contents of processing in the semiconductor fabrication machines and equipment concerning the 1st example of this invention.

[Drawing 2] It is drawing showing the structure of a system containing the semiconductor fabrication machines and equipment of drawing 1 .

[Drawing 3] It is drawing showing wiring of the cross cable corresponding to all the control of flow used by RS-232 C.

[Drawing 4] It is drawing showing positioning of the procedure by which it is characterized [ of the semiconductor fabrication machines and equipment concerning the 2nd example of this invention ].

[Drawing 5] It is drawing showing the communication procedure in the usual RS-232 C.

[Drawing 6] When the semiconductor fabrication machines and equipment and the host computer of drawing 4 are connected with the cable of drawing 3 , it is drawing showing the communication procedure for forming a communication link.

[Drawing 7] It is drawing showing the flow of manufacture of the minute device which can be applied to this invention.

[Drawing 8] It is drawing showing the detailed flow of the wafer process in drawing 7 .

[Description of Notations]

1: A remote command message, 3, 5:event report message, 9:message, 10:response, 14, 21:semiconductor fabrication machines and equipment, a 15:characteristic part, 16:cross connection, 17, 22:host computer, 18:remote command processing-time table, 19-21 : table.

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[Translation done.]

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平10-256109

(43) 公開日 平成10年(1998) 9月25日

(51) Int.Cl.<sup>4</sup>  
H 0 1 L 21/02  
G 0 6 F 13/00

識別記号  
3 5 3

F I  
H 0 1 L 21/02 Z  
G 0 6 F 13/00 3 5 3 C

審査請求 未請求 請求項の数14 F D (全 9 頁)

(21) 出願番号 特願平9-72806  
(22) 出願日 平成9年(1997) 3月11日

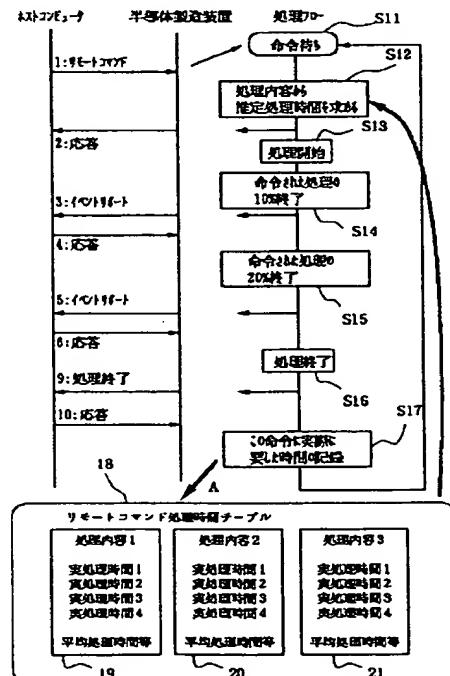
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(54) 【発明の名称】 半導体製造装置及びデバイス製造方法

(57) 【要約】 (修正有)

【課題】 ホストコンピュータとの間の必要な情報の授受を支障なく効率的に行えるようにして、半導体デバイスの製造の効率化を図る。

【解決手段】 ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返送するプロトコルをサポートしたインターフェイスを有する情報処理手段により動作が制御される半導体製造装置において、情報処理手段は、ホストコンピュータからコマンドのメッセージ1を受信したときは、返信メッセージ2に、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませる。あるいは、ホストコンピュータからのコマンドのメッセージを受信し、返信メッセージを送信した後、そのコマンドの処理の進捗状況に関するデータ3、5を所定のタイミングでホストコンピュータに送信する。



## 【特許請求の範囲】

【請求項1】 ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返送するプロトコルをサポートしたインターフェイスを有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記情報処理手段は、前記ホストコンピュータからコマンドのメッセージを受信したときは、前記返信メッセージに、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませるものであることを特徴とする半導体製造装置。

【請求項2】 前記情報処理手段は、前記返信メッセージに前記コマンドの受領の旨および実行可否のデータを含ませるものであることを特徴とする請求項1記載の半導体製造装置。

【請求項3】 前記情報処理手段は、同一の前記コマンドの処理について以前に要した処理時間を考慮して前記推定時間を得るものであることを特徴とする請求項1または2に記載の半導体製造装置。

【請求項4】 前記情報処理手段は、ある前記コマンドの推定処理時間と実際に要した時間を記憶し、これらの処理時間に統計処理を施すことにより、そのコマンドのより正確な推定処理時間を得るものであることを特徴とする請求項3記載の半導体製造装置。

【請求項5】 前記情報処理手段は、前記ホストコンピュータからのコマンドのメッセージを受信し、前記返信メッセージを送信した後、そのコマンドの処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信するものであることを特徴とする請求項1～4記載の半導体製造装置。

【請求項6】 ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返送するプロトコルをサポートしたインターフェイスを有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記情報処理手段は、前記ホストコンピュータからのコマンドのメッセージを受信し、前記返信メッセージを送信した後、そのコマンドの処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信するものであることを特徴とする半導体製造装置。

【請求項7】 請求項1～5のいずれかの半導体製造装置を用いて半導体デバイスを製造するデバイス製造方法において、ホストコンピュータからコマンドのメッセージを受信したとき、それに対する返信メッセージに、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませて、その返信メッセージをホストコンピュータに送信し、その後、前記コマンドに対応する処理を行って前記半導体製造装置の動作を制御し、半導体デバイスを製造することを特徴とするデバイス製造方法。

【請求項8】 前記コマンドの処理の進捗状況に関する

データを所定のタイミングで前記ホストコンピュータに送信することを特徴とする請求項7記載のデバイス製造方法。

【請求項9】 請求項6の半導体製造装置を用いて半導体デバイスを製造するデバイス製造方法において、ホストコンピュータからのコマンドのメッセージを受信したとき、それに対する必要な返信メッセージを送信し、その後、そのコマンドの処理を開始し、そしてその処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信しながら、半導体デバイスを製造することを特徴とするデバイス製造方法。

【請求項10】 ホストコンピュータに対してRS-232-C規格を満足するすべての流量制御に対応したクロスケーブルによる信号線を介して接続された情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、RS-232-C規格において有り得るすべての前記信号線を介した入力を監視し、前記ホストコンピュータからAA、BA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備することを特徴とする半導体製造装置。

【請求項11】 ホストコンピュータとの間の、SEC S-1に従った通信インターフェイスを介した通信手段を有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記通信インターフェイスは、物理的インターフェイスとして、前記ホストコンピュータと前記情報処理手段との間の、Dタイプ25ピンのコネクタによる、AA、BA、BBおよびABの信号線による接続に加え、CA、CB、CCおよびCDのクロスケーブルによる接続とを有し、前記通信手段は、前記ホストコンピュータからAA、BA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備することを特徴とする半導体製造装置。

【請求項12】 ホストコンピュータとの間の、SEC S-1に従った通信インターフェイスを介した通信手段を有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記通信インターフェイスは、物理的インターフェイスとして、前記ホストコンピュータと前記情報処理手段との間の、Dタイプ9ピンのコネクタによる、BA、BBおよびABの信号線による接続に加え、CA、CB、CCおよびCDのクロスケーブルによる接続とを有し、前記通信手段は、前記ホストコンピュータからBA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備することを特徴とする半導体製造装置。

【請求項13】 前記通信手段は、前記ホストコンピュータから送信要求(CA)を受信したときは、これに応じた送信可(CB)の返信およびデータ(BB)の受信を行い、前記ホストコンピュータからデータ端末レディ(CD)を受信したときは、これに応じたデータセットレディ(CC)の返信およびデータ(BA)の送信を行い、そして、前記ホストコンピュータから送信要求(CA)またはデータ端末レディ(CD)のいずれも受信していないときは、必要に応じて前記ホストコンピュータとの間でデータ(BA)の送信またはデータ(BB)の受信を行うものであることを特徴とする請求項11または12記載の半導体製造装置。

【請求項14】 請求項10～13のいずれかの半導体製造装置を用い、そのホストコンピュータとの間でその通信手段を介して必要な情報の交換を行い、それらの情報に基づいて前記半導体製造装置の動作を制御して、半導体デバイスを製造することを特徴とするデバイス製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、コンピュータまたはコンピュータネットワーク中の半導体製造装置との情報交換を行ない半導体製造装置を制御するホストコンピュータと接続された半導体製造装置およびこれを用いたデバイス製造方法に関する。

【0002】

【従来の技術、および発明が解決しようとする課題】従来、ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返すプロトコルをサポートしたインターフェイスを持つ半導体製造装置においては、リモートコマンドメッセージ等の受信と返信処理に際し、リモートコマンドの実行が現状において可能か否かや、受信と返信の通信処理の成否をホストコンピュータに伝え、また、リモートコマンドの意味する実際の処理が終了した際、処理が終了した旨をホストコンピュータに伝える。

【0003】しかしながら半導体製造装置を制御するホストコンピュータは年々高度化し、ホストコンピュータ上で細かい装置状態を把握したいという状況も多く、特に時間のかかる作業を命令するリモートコマンドと、これに対してイベントによる作業状況を通知するといった形式の半導体製造装置の制御においては、いつ作業が終了するか予想がつかないという問題を抱えている。そこで半導体製造装置に対し以下の様な課題が挙げられる。

① ホストコンピュータから受けたコマンドによる命令に応じた処理をどの程度の時間で実行できるのか、半導体製造装置はホストコンピュータに対して通知する必要がある。

② 通知する処理の所要時間の推定は可能な限り正確である必要がある。

③ 半導体製造装置は現在処理がどの程度進んでいるのか逐次ホストコンピュータへ報告する必要がある。

【0004】一方、半導体製造装置とホストコンピュータ間のメッセージ送受信に関する通信インターフェイスを定義するSECS-1は、AA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)(信号名称はEIA RS-232C規格に基づく)がすべての装置における必要な信号線の接続であるとしている。また、それ以外の信号線を使用する場合はRS-232-C規格に準拠しなければならないとしている。そして従来、SECS-1に準拠した半導体製造装置においては、SECS-1に示されるAA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)のみを用いてホストコンピュータと接続するものとしてきた。ホストコンピュータが、AA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)以外の信号線による接続(CA、CCの使用など)を必要とする場合、半導体製造装置はAA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)のみしか使用していないため、ホストコンピュータと半導体製造装置間のクロスケーブルにおいて物理的にAA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)以外の信号線を、通信が成立するように(CAはCBと、CCはCDと)短絡している。

【0005】しかしながら、ホストによって要求する物理的な信号線の接続方法は次に示すように多岐に渡る。

① AA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)のみの信号線の接続(SECS-1の基本的な方針)

② ①の接続に加え、CD(20pin)とCC(6pin)の信号線の接続(RS-232-Cに準拠)

③ ①の接続に加え、CA(4pin)とCB(5pin)の信号線の接続(RS-232-Cに準拠)

④ ①の接続に加え、CD、CC、CA、CBの信号線の接続(RS-232-Cに準拠)

【0006】以上の要求を満たすため、通信が成立するようなクロスケーブルをホストコンピュータと半導体製造装置の間でそれぞれの場合に合わせて用意するのは繁雑である。また、クロスケーブルの選択ミスによる通信障害も起こり得る(不必要な信号線を接続すると通信障害が起こる)。

【0007】本発明の目的は、上述の従来の問題点に鑑み、半導体製造装置および方法において、ホストコンピュータとの間の必要な情報の授受を支障なく効率的に行えるようにして、半導体デバイスの製造の効率化を図ることにある。

【0008】

【課題を解決するための手段】この目的を達成するため本発明の一態様に係る半導体製造装置では、ホストコン

ピュータからの送信メッセージに対し、必要であれば返信メッセージを返送するプロトコルをサポートしたインターフェイスを有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記情報処理手段は、前記ホストコンピュータからコマンドのメッセージを受信したときは、前記返信メッセージに、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませるものであることを特徴とする。

【0009】また、本発明の一態様に係るデバイス製造方法においては、このような半導体製造装置を用いて半導体デバイスを製造するデバイス製造方法において、ホストコンピュータからコマンドのメッセージを受信したとき、それに対する返信メッセージに、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませて、その返信メッセージをホストコンピュータに送信し、その後、前記コマンドに対応する処理を行って前記半導体製造装置の動作を制御し、半導体デバイスを製造することを特徴とする。

【0010】また、本発明の他の態様に係る半導体製造装置においては、ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返送するプロトコルをサポートしたインターフェイスを有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記情報処理手段は、前記ホストコンピュータからのコマンドのメッセージを受信し、前記返信メッセージを送信した後、そのコマンドの処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信するものであることを特徴とする。

【0011】また、本発明の他の態様に係るデバイス製造方法においては、前記他の態様に係る半導体製造装置を用いて半導体デバイスを製造するデバイス製造方法において、ホストコンピュータからのコマンドのメッセージを受信したとき、それに対する必要な返信メッセージを送信し、その後、そのコマンドの処理を開始し、そしてその処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信しながら、半導体デバイスを製造することを特徴とする。

【0012】また、本発明の別の態様に係る半導体製造装置では、ホストコンピュータに対してRS-232-C規格を満足するすべての流量制御に対応したクロスケーブルによる信号線を介して接続された情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、RS-232-C規格において有り得るすべての前記信号線を介した入力を監視し、前記ホストコンピュータからAA、BA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備することを特徴とする。

【0013】また、本発明の別の態様に係るデバイス製造方法では、このような半導体製造装置を用い、そのホストコンピュータとの間でその通信手段を介して必要な情報の交換を行い、それらの情報に基づいて前記半導体製造装置の動作を制御して、半導体デバイスを製造することを特徴とする。

【0014】

【発明の実施の形態】前記本発明の一態様に係る半導体製造装置およびデバイス製造方法においては、ホストコンピュータからコマンド（リモートコマンド）を受けたとき、その返信メッセージにコマンドの受領、実行可否、受信返信通信処理の成否等のデータを含ませることができる。

【0015】また、コマンドの処理に要する推定時間は、同一のコマンドの処理について以前に要した処理時間を考慮して得ることができる。より具体的には、あるコマンドの推定処理時間と実際に要した時間を記憶しておき、これらの処理時間に統計処理を施すことにより、そのコマンドのより正確な推定処理時間を得ることができる。つまり、ホストコンピュータから送信メッセージのリモートコマンドとして命令される可能性のある各処理について、実処理時間を複数回分蓄積しておき、これに基づいて推定処理時間をより正しいものに算出しながら返信メッセージ送信時にホストコンピュータに通知する。これによりホストコンピュータからの処理実行命令を多く繰返す程、より正確な処理推定時間をホストコンピュータに通知できるようになる。

【0016】このようにして、ホストコンピュータからの送信メッセージがリモートコマンドなどによる処理実行の命令などであった場合、そのコマンドの現状可否や受信返信通信処理の成否の他にその処理の推定所要時間を返信メッセージとしてホストコンピュータに報告することにより、ホストコンピュータは半導体製造装置がどの程度で処理を完了するのかを大まかに把握し、例えば別の処理を並行して先に行なっておくことも可能になる。また、推定所要時間を大幅に経過してもまだ、半導体製造装置から処理終了を示す報告がない時はその処理自体になんらかの異常が起ったことを検出することができる。さらにオペレータはホストコンピュータを見ることで、あとの程度の時間、半導体製造装置に対するオペレーションが必要ないのかを判断することができる。

【0017】また、前記本発明の他の態様においては、例えば、ホストコンピュータからのリモートコマンドの処理の進捗状況に関するデータを、イベントリポートとしてホストコンピュータに通知する。これによりホストコンピュータは推定処理時間に合わせて、実際の処理がどの程度進んでいるかを把握することができる。

【0018】一方、本発明の別の態様に係る半導体製造装置およびデバイス製造方法においては、具体的には、

ホストコンピュータとの間の、SECS-1に従った通信インターフェイスを介した通信手段を有する情報処理手段を備え、この情報処理手段により動作が制御される半導体製造装置において、前記通信インターフェイスは、物理的インターフェイスとして、前記ホストコンピュータと前記情報処理手段との間の、Dタイプ25ピンのコネクタによる、AA、BA、BBおよびABの信号線による接続に加え、CA、CB、CCおよびCDのクロスケーブルによる接続とを有し、前記通信手段は、前記ホストコンピュータからAA、BA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備する。

【0019】あるいは前記通信インターフェイスは、物理的インターフェイスとして、前記ホストコンピュータと前記情報処理手段との間の、Dタイプ9ピンのコネクタによる、BA、BBおよびABの信号線による接続に加え、CA、CB、CCおよびCDのクロスケーブルによる接続とを有し、前記通信手段は、前記ホストコンピュータからBA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させる手段を具備する。

【0020】前記通信手段は、ホストコンピュータから送信要求(CA)を受信したときは、これに応じた送信可(CB)の返信およびデータ(BB)の受信を行い、前記ホストコンピュータからデータ端末レディ(CD)を受信したときは、これに応じたデータセットレディ(CC)の返信およびデータ(BA)の送信を行うことにより、前記通信を成立させてデータの送受信を行うことができる。そして、前記ホストコンピュータから送信要求(CA)またはデータ端末レディ(CD)のいずれも受信していないときは、必要に応じて前記ホストコンピュータとの間でデータ(BA)の送信またはデータ(BB)の受信を行うことができる。

【0021】このようにして、ホストコンピュータがどのような信号線の接続方法を要求している場合でも、ホストコンピュータと半導体製造装置間で使用するケーブルはRS-232-C規格の全ての流量制御に対応したクロスケーブル(通常のクロスケーブル)による信号線の接続方法の1つに定めておき、RS-232-C規格に有り得る全てのピンを監視し、ホストコンピュータからの要求があれば、AA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)以外のピンに対し送受信の手順には関係なく応答を返すことで通信を成立させることにより、半導体製造装置側でホストの要求する信号線接続の違いを吸収することができる。

【0022】

【実施例】以下本発明の実施例を図面を用いて説明する。

【第1の実施例】図2は本発明の第1の実施例に係る半導体製造装置を含むシステムの構成を示す図である。同図に示すように、このシステムは半導体製造装置21とそれを制御するホストコンピュータ22を有し、半導体製造装置21とホストコンピュータ22はRS-232-Cインターフェイスまたはイーサネット(TCP/IP)により接続されている。

【0023】物理的インターフェイスの上のよりアプリケーションに近いインターフェイスは、一般的にはSEMI(SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL)による通信規約、SECS-1、SECS-2、HSMS等によっている。それらの通信規約に依存しない場合でも、ホストコンピュータからの送信メッセージに対し、必要であれば返信メッセージを返信する通信インターフェイスをサポートするものであればよい。

【0024】図1は半導体製造装置21における通信と処理内容を示す図である。同図に示すように、半導体製造装置は始めにホストコンピュータからの命令を待っている状態(ステップS11)にある。この状態において、ホストコンピュータからリモートコマンドメッセージ1によって何らかの命令が送られてくると、半導体製造装置はその命令にどの程度の時間がかかるか、リモートコマンド処理時間テーブル18を参照し、ホストコンピュータからの命令を元に処理推定時間を求め、求めた処理推定時間を応答メッセージ2に載せてホストコンピュータへ報告する(ステップS12)。このリモートコマンドのトランザクションが終了すると、半導体製造装置はコマンドにより命令された処理を開始する(ステップS13)。そして命令された処理の任意の割合の処理が終了した時、半導体製造装置は、イベントリポートメッセージ3、5として、現在、処理の何割が終了したかをホストコンピュータへ通知する(ステップS14、S15)。

【0025】半導体製造装置は、ホストコンピュータからのリモートコマンドによる命令の処理を終了すると、通常、ホストコンピュータに、処理が終了した旨を知らせるメッセージ9を送信する(ステップS16)。メッセージ9に対する応答10を受信してメッセージ9のトランザクションが完了した後、半導体製造装置は、ホストコンピュータからのリモートコマンド1による命令の処理を行うには実際にはどの程度かかったかを、リモートコマンド処理時間テーブル18内の今回の命令に相当する処理内容を有するテーブル、例えばテーブル19などに記録する(ステップS17)。その後は再びホストコンピュータからのリモートコマンドによる命令待ちの状態(ステップS11)に戻る。

【0026】次に、先程処理したのと同様の命令実行を示すリモートコマンドがホストコンピュータから送信されてくると、先程より更に正確になった推定実行所要時間を載せた、リモートコマンドの応答をホストコンピュ

ータへ返すことができる(ステップS12)。

【0027】〔第2の実施例〕表1は本実施例で使用されるRS-232-C規格における各ピンの役割を示す。1ピンはAAと呼ばれ保安用接地に、2ピンはBAと呼ばれ送信データ用に、3ピンはBBと呼ばれ受信データ用に、4ピンはCAと呼ばれ送信要求用に、5ピン

はCBと呼ばれ送信可能を示すために、6ピンはCCと呼ばれデータセットレディを示すために、7ピンはABと呼ばれ信号用接地に、20ピンはCDと呼ばれデータ端末レディを示すために用いられる。

【0028】

【表1】

Table 1: RS-232-C 各ピンの働き

ピン	略 称	用 途
1	AA	保安用接地
2	BA	送信データ
3	BB	受信データ
4	CA	送信要求
5	CB	送信可
6	CC	データセットレディ
7	AB	信号用接地
20	CD	データ端末レディ

【0029】図3はRS-232-Cで用いられる全ての流量制御に対応したクロスケーブルの配線を示す。図中の数字は、ピンの番号である。本実施例ではホストコンピュータと半導体製造装置間の物理的インターフェイスとして図1の配線のケーブルを使用する。図中の数字は、双方のコネクタにおけるピンの番号である。同図に示すように、このケーブルは1ピンは相手の1ピンに接続し、2ピンは相手の3ピンに接続する。4ピンは相手の5ピンに接続し、6ピンは相手の20ピンに接続する。7ピンは相手の7ピンに接続する。

【0030】図4は本実施例の特徴とする手順の位置付けを示す。同図に示すように、本実施例の特徴的部分15は半導体製造装置14と、これとホストコンピュータ17を接続する図1のクロス接続16との間にあり、クロス接続16を介してホストコンピュータ17と接続している。

【0031】図5は通常のRS-232-Cにおける通信手順を示す。通常のRS-232-Cに基づく通信では、お互いの流量制御を期待しているため、送信要求を通信相手から受信しない限りデータの受信は開始されない。同様に、通信相手にデータを送信する場合は必ずデータ端末レディを受信しないと、相手はデータを受信できる状態にならない。

【0032】この具体的な通信手順を図5に従い示す。通信を開始すると、半導体製造装置は、通信相手から送信要求を受信したか否かを調べ(ステップS2)、送信要求を受信しているときは通信相手に送信可能であることを送信(ステップS3)し、データの受信を行う(ステップS4)。通信相手から送信要求を受信していなけ

れば、データ端末レディを受信しているか否かを調べ(ステップS5)、データ端末レディを受信していれば通信相手にデータ送信できるので通信相手にデータセットレディを送信し(ステップS6)、その後データの送信を行う(ステップS7)。データ端末レディを受信していなければ、再び一定時間後などに送信要求を受信したかの判断(ステップS2)に戻る。あとは以上の繰り返しにより半2重通信を継続していく。

【0033】図6は本実施例に係る半導体製造装置とホストコンピュータとを図3のケーブルにより接続した場合、ホストコンピュータがAA(pin1)、BA(pin2)、BB(pin3)、AB(pin7)以外のピンを用いた通信手順である流量制御を要求していても通信を成立させるための通信手順を示す。本発明の特徴的な部分である。SECS-1では半2重通信により通信を行う2つの機器(ここでは半導体製造装置とホスト)の間で交わされるメッセージの送受信の手順まで定めているため、より一般的なRS-232C規格に示されるCAとCBによる流量制御や、CCやCDによる流量制御は必要とされない。このことからSECS-1に準拠した半導体製造装置は、物理的インターフェイスの他(メッセージ送受信規約等)はSECS-1に準拠したホストコンピュータとの通信を、以下の手順によって成立させることができる。

【0034】つまり図6に示すように、通信を開始すると、通信相手から送信要求を受信したか否かを調べ(ステップS41)、もし送信要求を受信していれば、送信可能を通信相手に送信し(ステップS42)、その後、データの受信を行う(ステップS45)。もし送信要求

を受信していなければ、データ端末レディを通信相手から受信したか調べ（ステップS43）、受信していればデータセットレディを通信相手に送信し（ステップS44）、その後、データの送信を行なう（ステップS45）。もしデータ端末レディを受信していなければ、必要に応じてデータの受信および／または送信を行うことができる（ステップS45）。SECS-1の通信規約に準拠している限り通信の衝突は起こり得ないため、ステップS45においてデータを送信したければすば良し、データを受信している間は送信の要求は起こらない。以後は一定時間経過後などにステップS41に戻り、半2重通信を継続していく。

【0035】次に、上述のような半導体製造装置を利用することができるデバイス製造例を説明する。図7は微小デバイス（ICやLSI等の半導体チップ、液晶パネル、CCD、薄膜磁気ヘッド、マイクロマシン等）の製造のフローを示す。ステップ31（回路設計）では半導体デバイスの回路設計を行なう。ステップ32（マスク製作）では設計した回路パターンを形成したマスクを製作する。一方、ステップ33（ウエハ製造）ではシリコン等の材料を用いてウエハを製造する。ステップ34（ウエハプロセス）は前工程と呼ばれ、上記用意したマスクとウエハを用いて、リソグラフィ技術によってウエハ上に実際の回路を形成する。次のステップ35（組み立て）は後工程と呼ばれ、ステップ34によって作製されたウエハを用いて半導体チップ化する工程であり、アッセンブリ工程（ダイシング、ボンディング）、パッケージング工程（チップ封入）等の工程を含む。ステップ36（検査）では、ステップ35で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行なう。こうした工程を経て半導体デバイスが完成し、これを出荷（ステップ37）する。

【0036】図8は上記ウエハプロセスの詳細なフローを示す。ステップ41（酸化）ではウエハの表面を酸化させる。ステップ42（CVD）ではウエハ表面に絶縁膜を形成する。ステップ43（電極形成）ではウエハ上に電極を蒸着によって形成する。ステップ44（イオン打ち込み）ではウエハにイオンを打ち込む。ステップ45（レジスト処理）ではウエハに感光剤を塗布する。ステップ46（露光）では、露光装置によってマスクの回路パターンをウエハに焼付露光する。ステップ47（現像）では露光したウエハを現像する。ステップ48（エッチング）では現像したレジスト像以外の部分を削り取る。ステップ49（レジスト剥離）では、エッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行なうことによってウエハ上に多重に回路パターンを形成する。

【0037】本実施形態の製造方法を用いれば、従来は製造が難しかった高集積度の半導体デバイスを低コストで製造することができる。

【0038】

【発明の効果】以上説明したように本発明によれば、ホストコンピュータからコマンドのメッセージを受信したとき、それに対する返信メッセージに、そのコマンドの処理が終了するまでの推定時間を1つのパラメータとして含ませるようにしたため、ホストコンピュータはその推定時間に基づいて、例えば別の処理を並行して先に行なったり、処理の異常を検出する等により、半導体デバイスの製造の効率化を図ることができる。また、オペレータはその推定時間を見ることにより、あとの程度の時間、半導体製造装置に対するオペレーションが必要なのかを判断することができる。

【0039】また、同一の前記コマンドの処理について以前に要した処理時間を考慮してそのコマンドの処理に要する推定時間を得るようにしたため、正確な推定時間を得ることができる。

【0040】また、ホストコンピュータからのコマンドのメッセージを受信し、その返信メッセージを送信した後、そのコマンドの処理の進捗状況に関するデータを所定のタイミングで前記ホストコンピュータに送信するようにしたため、ホストコンピュータは、実際の処理がどの程度進んでいるかを把握し、これに基づいて半導体デバイスの製造を効率的に行うための必要な判断を行うことができる。

【0041】また、RS-232-C規格において有り得るすべての信号線を介した入力を監視し、ホストコンピュータからAA、BA、BBおよびAB以外の信号線を介したデータ通信要求があれば、これに応じた返信を対応する信号線を介して行うことにより通信を成立させるようにしたため、半導体製造装置とホストコンピュータとの接続ケーブルを、ホストコンピュータが要求する信号線の接続方法に応じて取り換える必要をなくすことができ、かつケーブルの選択ミスによる通信障害を防止することができる。

【図面の簡単な説明】

【図1】 本発明の第1の実施例に係る半導体製造装置における通信と処理内容を示す図である。

【図2】 図1の半導体製造装置を含むシステムの構成を示す図である。

【図3】 RS-232-Cで用いられる全ての流量制御に対応したクロスケーブルの配線を示す図である。

【図4】 本発明の第2の実施例に係る半導体製造装置の特徴とする手順の位置付けを示す図である。

【図5】 通常のRS-232-Cにおける通信手順を示す図である。

【図6】 図4の半導体製造装置とホストコンピュータとを図3のケーブルにより接続した場合に通信を成立させるための通信手順を示す図である。

【図7】 本発明に適用し得る微小デバイスの製造のフローを示す図である。

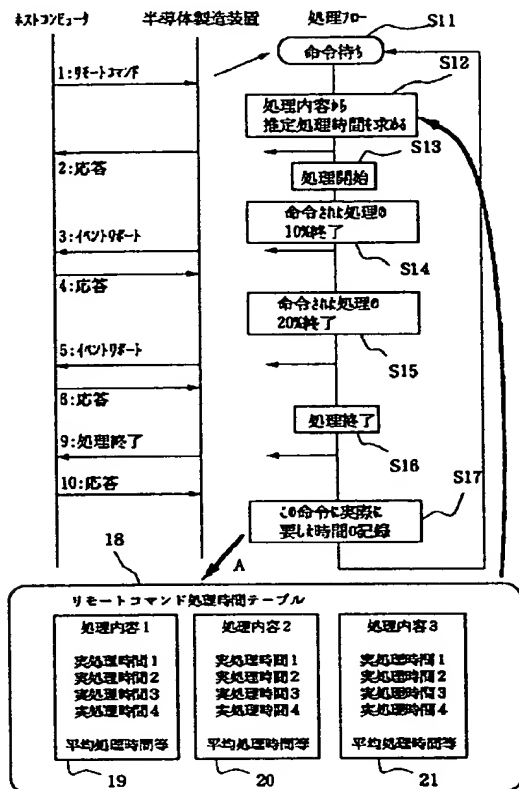
【図8】 図7中のウェハプロセスの詳細なフローを示す図である。

【符号の説明】

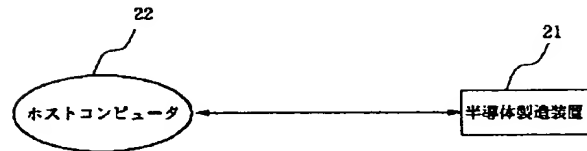
1：リモートコマンドメッセージ、3、5：イベントリポートメッセージ、9：メッセージ、10：応答、1

4, 21：半導体製造装置、15：特徴的部分、16：クロス接続、17, 22：ホストコンピュータ、18：リモートコマンド処理時間テーブル、19～21：テーブル。

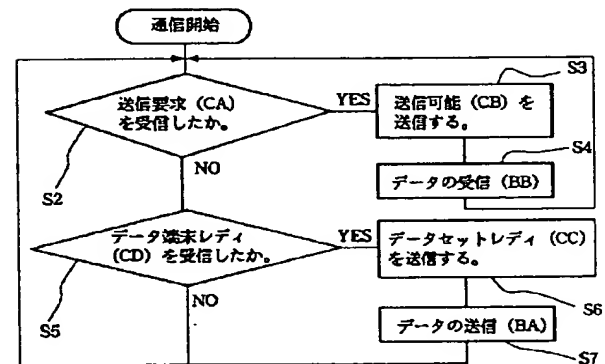
【図1】



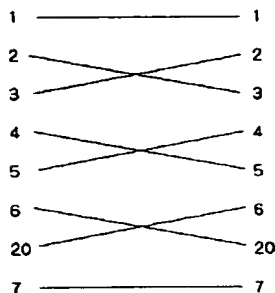
【図2】



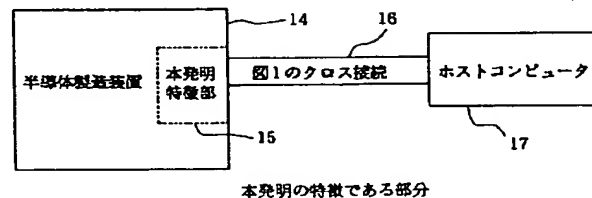
【図5】



【図3】

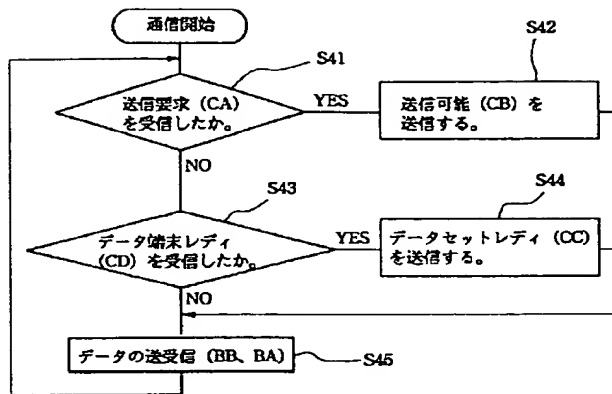


【図4】

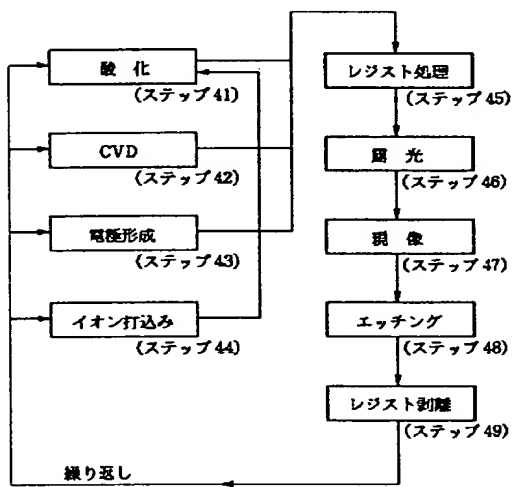


本発明の特徴である部分

【図6】

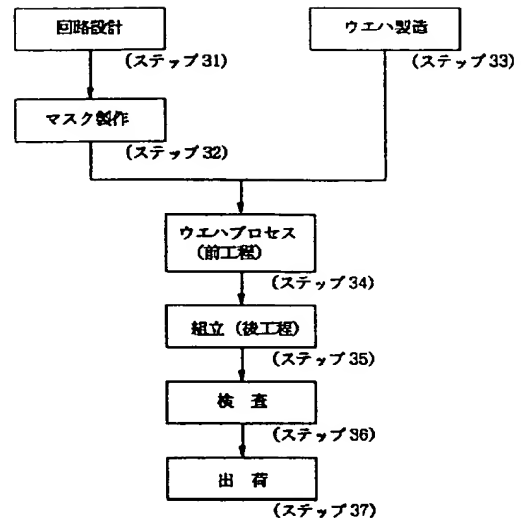


【図8】



ウエハプロセス

【図7】



半導体デバイス製造フロー